SMOS Canadian field campaigns

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Contexte

- SMOS/SMAP radiometers

  L-band (1.23 GHz)

  Similar spatial resolution and revisit time

  Incidence angle : 40 ° for SMAP

  0° to 60° for SMOS

- 2 years delay in the launch date of SMOS

  Expected launch date : November 2, 2009

Outline

- Activities in preparation to the use of SMOS data
  - Partnership between Universities and Environment Canada researchers
  - Field campaigns in 2008 (summer and fall)
- SMOS Canadian field campaign in 2010
  - **Ground data collection** (Ramata Magagi)
  - **Aircraft operation** (Anne Walker)

Activities in preparation to SMOS data

Partnership

- Researchers involved in SMOS validation and retrieval activities over land surfaces :

  Ramata Magagi and Kalifa Goita (University of Sherbrooke)

  Aaron Berg (University of Guelph),

  Robert Leconte (University of Quebec),

  Stephane Belair, Anne Walker and Brenda Toth (Environment Canada)

→ Provide Canadian contribution to SMOS mission over land surfaces

Partnership

- 2005 : Proposal submitted to ESA (SMOS mission calibration-validation announcement opportunity) → access to SMOS data free of charge
- 2007 : Proposal submitted to NSERC-SPG to fund SMOS cal/val activities

«Assessment of Canadian **Soil Water Resources** and **Freeze/Thaw conditions** Through Microwave Remote Sensing and **Data assimilation**» → (K$ 467)

Objectives of NSERC-SPG project

- Soil moisture estimation based on passive and active microwave data (SMOS, Radarsat-2, ENVISAT, ALOS);
- Monitoring of soil's freeze/thaw conditions from SMOS and RADARSAT-2 data in Canada.
- Validation of SMOS (L1 and L2) data over Canadian sites
- Scaling methods of soil moisture
- Assimilation of SMOS data in land surface systems to improve the surface initial conditions provided to environmental forecast models

Modeling

Soil moisture inversion algorithm

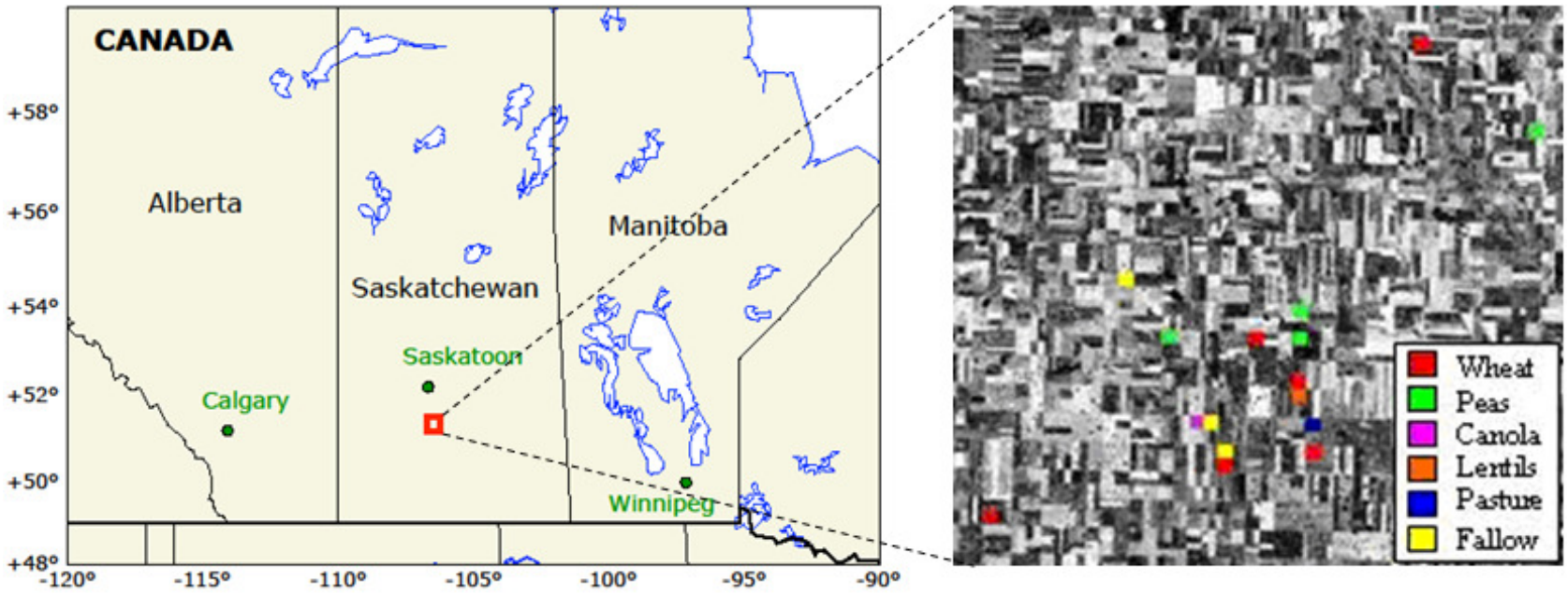
Field campaigns

Study sites

Three different landscapes types in Canada:

- **Prairies** in Saskatchewan [51.15-52.15 N, 105.74-106.74 W]
- **Agricultural areas** in Southern Ontario, [43.1-44.1 N; 80.0 - 81.85W] and in Western Canada [49.3N-50.3N, 105.3-104W].and
- **Forested site** BERMS [53.35-54.5N, 104-106.5W]

Agricultural area in Saskatoon



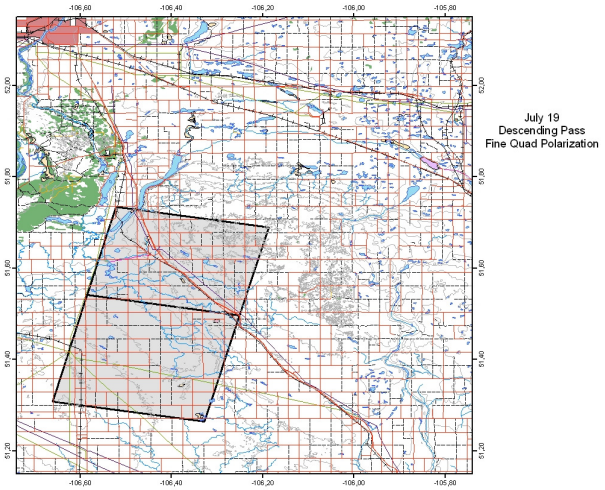
Two field campaigns in 2008:

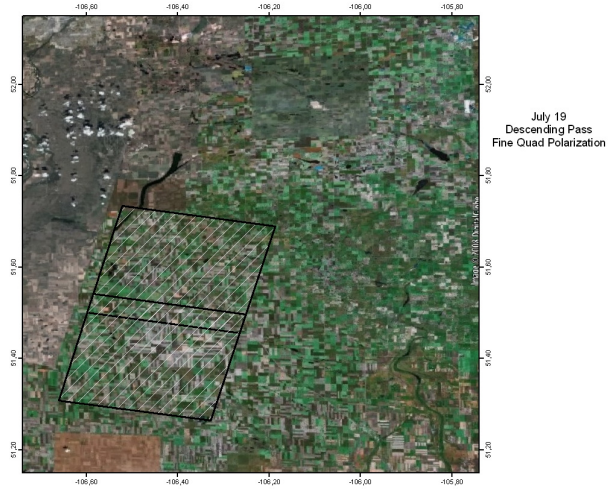
- Summer (Soil moisture)
- Fall (Freeze/Thaw)

Available satellite data

- Radarsat-2

Day (July 2008)	Flight direction	Beam mode	Resolution (m)×(m)	Incidence angle (°)	Polarization
19	D	Fine quad-pol	9×5	28-30	All
20	A	Scan narrow	25×25	30-47	HH, HV
23	D	Fine	6×5	30-47	HH, HV
23	A	Scan narrow	25×25	30-47	HH, HV





- AMSR-E

Saskatoon field measurements

- Soil : moisture, roughness, temperature, texture
- Vegetation : Cover, water content, height, density

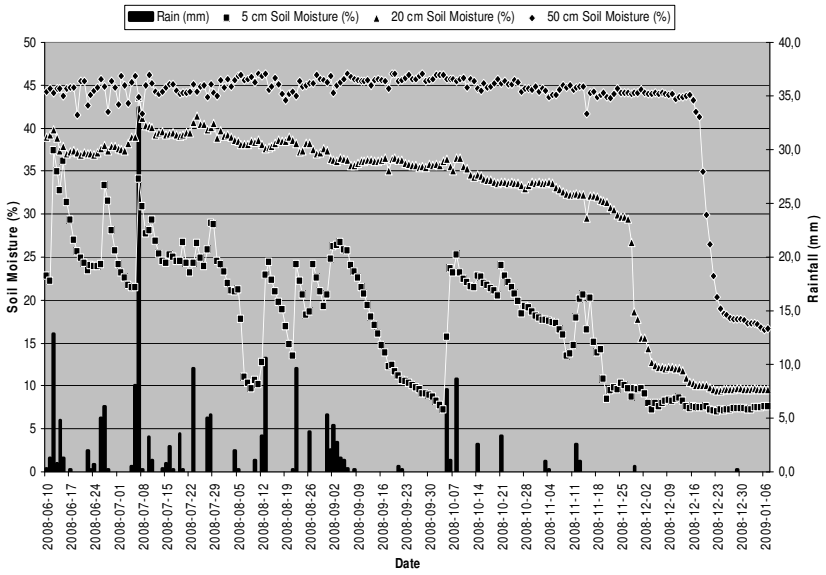
Ground measurements

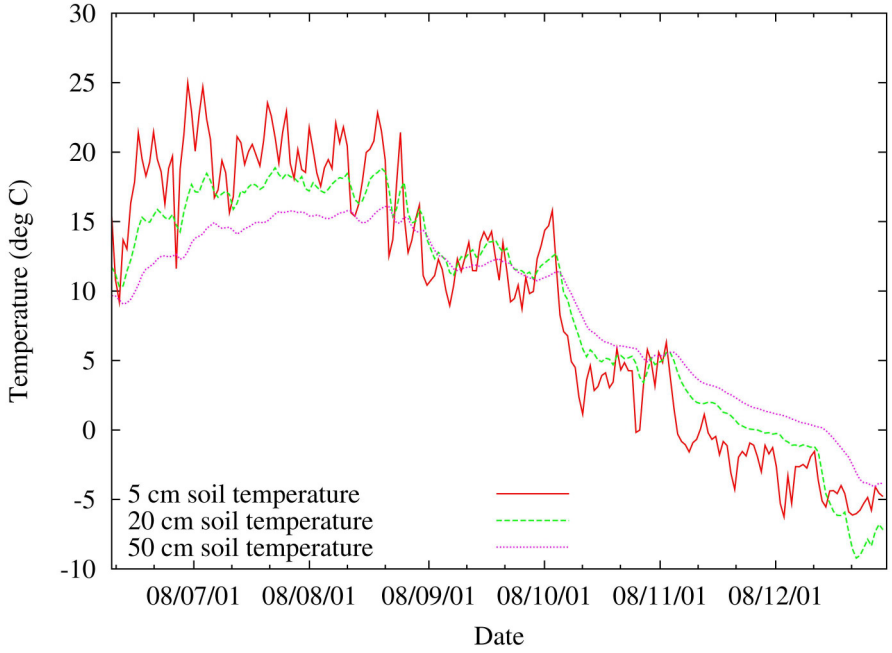
- Saskatoon 2008 : **soil moisture and temperature**
  - Aaron network (16 sites)
  - Brenda network (24 sites)
  - Data collection over the sites

Ground data measurements

- Exemple of Brenda network data

  Saskatoon (NE09) – June-Dec. 2008



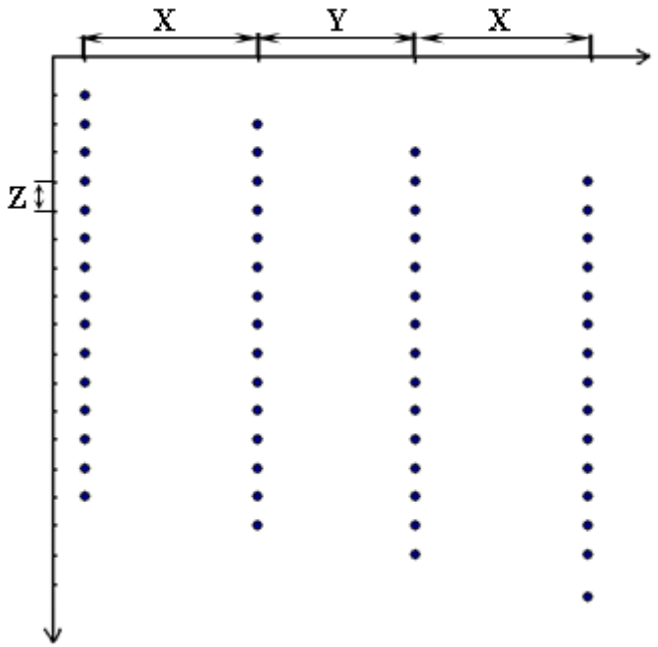


Ground data measurements

- Soil moisture data collection

- Use of Hydra Probe II

- Spatial sampling with respect to Radarsat-2 acquisition mode



Spatial sampling (m)	Fine mode	Scan SAR mode
X	10	10
Y	10	50
Z	2	4

Ground data measurements

- Roughness measurements

Summer

Fall

Ground data measurements

- Vegetation characteristics, for each field :

  - Crop heigths

  - Vegetation water content from samples collected over an area of 50 x 50 cm2

  - Row spacing

Ground measurements

- Saskatoon 2008

Date	Site	Crop type	Average Roughness height (cm)	Correlation Length (cm)	Average Crop height (cm)	Water content (kg/m^2)
19 July	03SW	Wheat	1.6	12	73.78	2.08
	29NW	Peas	1.47	11.67	45.45	2.92
	09NE	Fallow	2.42	39.83	10.70	-
	07NW	Pasture	1.87	44.17	24.00	0.54
	09NW	Canola	1.81	10	97.08	5.10
20 July	2R	Wheat	1.76	24	32.61	-
	9R		1.78	10.83	73.03	-
	6R	Peas	1.52	10.67	43.98	-
	03NW	Fallow	1.86	16.83	0.00	-
	5R		1.36	13.83	15.56	-
24 July	24SE	Wheat	1.9	14.17	78.90	1.50
	26NW		2	9	76.00	1.55
	06NW		1.48	17.33	86.78	3.29
	36NE	Peas	1.78	21.33	50.38	3.15
	25NE		1.89	31.17	53.90	2.52
	13NE	Lentil	1.74	28.33	26.75	1.98

Methodology for soil moisture estimation

- Parameterisation of the backscattering model for each crop type
- Empirical relationships to estimate soil roughness, crop height and vegetation water content values for each field, and finally,
- Inversion of soil moisture for each field.

Method can be adapted to a synergy active/passive

SMOS Canadian field campaigns in 2010

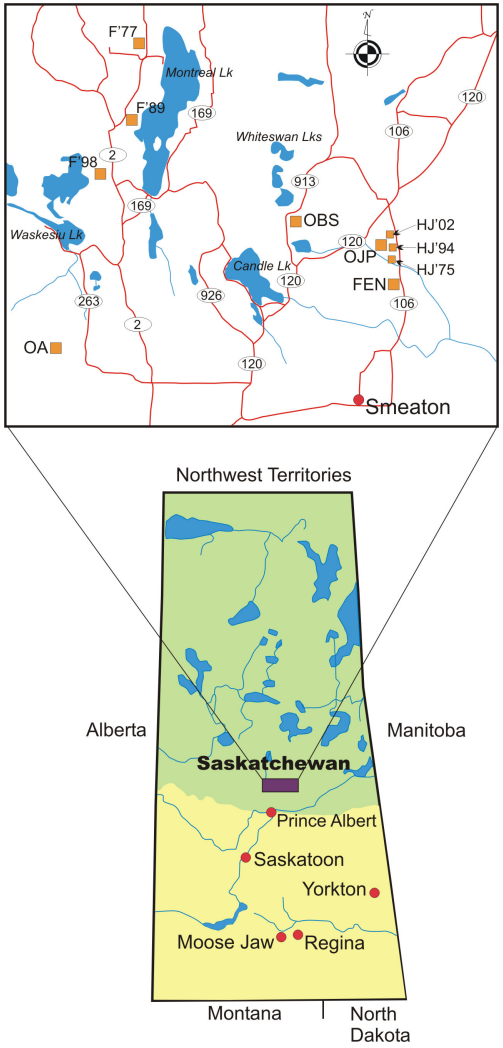
Sites

- In addition to **Prairie** and **agricultural** areas, **Berms** forested site :

  - Validation of SMOS products over forested area

  - Uncertainty due to wet understory in biomass estimation

Forested site : BERMS



http://berms.ccrp.ec.gc.ca/Sites/e-sites.htm

Field campaigns in 2010

- Extensive field campaigns like those of 2008
- Intensive field campaign (June 2010) in Saskatchewan. Coincident wih SMOS overpasses :

  - Ground data collection (soil and vegetation)

  - Aircraft data acquisition (**Anne Walker Presentation**)

Field campaigns in 2010

- Intensive soil moisture collection

  - Capture the L-Band response in 3 wetness conditions (dry, wet and intermediate)

- Over SMOS pixel (~ 35 km) , several transects to conduct flight operations

- For each transect, 20 soil moisture measurement points were planned

Spatio-temporal variability of soil moisture + research axe related to the scaling issu.

Expectation from SMAP

- Continue SMOS activities in Canada
- Very few ALOS data in Canada

  → repair the gap in L-band radar data
- Application/Improvement of algorithms developed with SMOS data

Ackowledgments

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- Aaron Berg
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- Kalifa Goita,
- Robert Leconte

Thanks